sPHENIX TPC R&D at WIS

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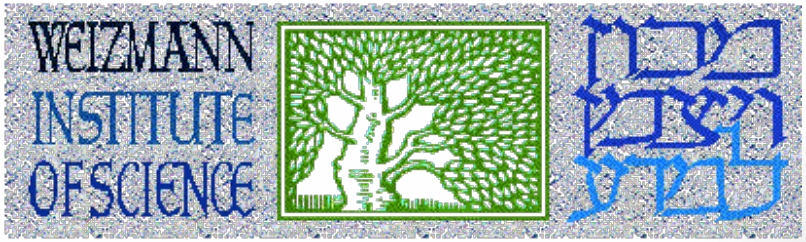


The clean room

About 50 m^2. Cleanness outside the LFT is between ISO-8 and ISO-7. Can secure more space when needed for the prototype and detector construction.

1. Rack with NIM crates, blue logic, standard NIM units.
2. LFT for GEM tests and assembly.
3. Olympus BXFM optical system.
4. CAEN HV mainframe with 12 channels HV module up to 5 kV.
5. Glassman HV power supply for up to 40 kV.
6. Gas system.
7. Test cells (old from HBD and new for TPC).
8. Data acquisition system for 512 channels.

Two main directions

1. Measure gas mixtures.
   a. Standard parameters, which are known, but for practical reasons we need to measure them in our setup
      - Gain
      - Drift velocity
      - Diffusion
   b. Specific parameters which are less or not known
      - Electron attachment
      - Ion backflow

2. Amplification element.
   a. Very low dead areas (<2%)
   b. Low cost
   c. High performance parameters

IBF measurements

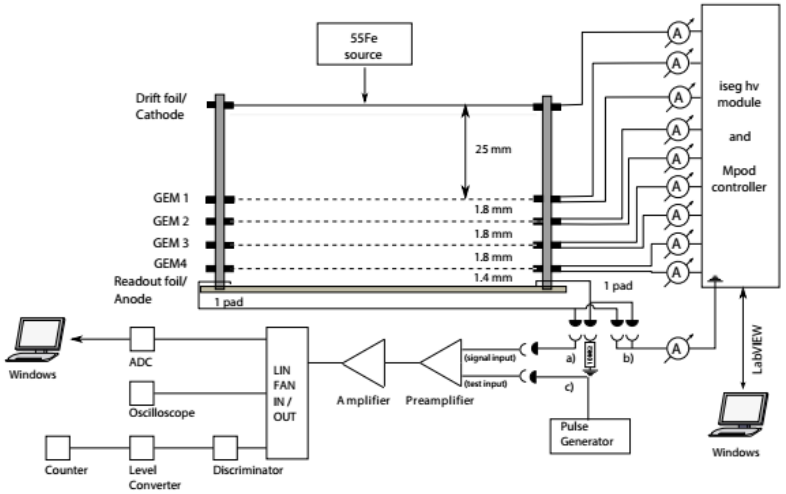
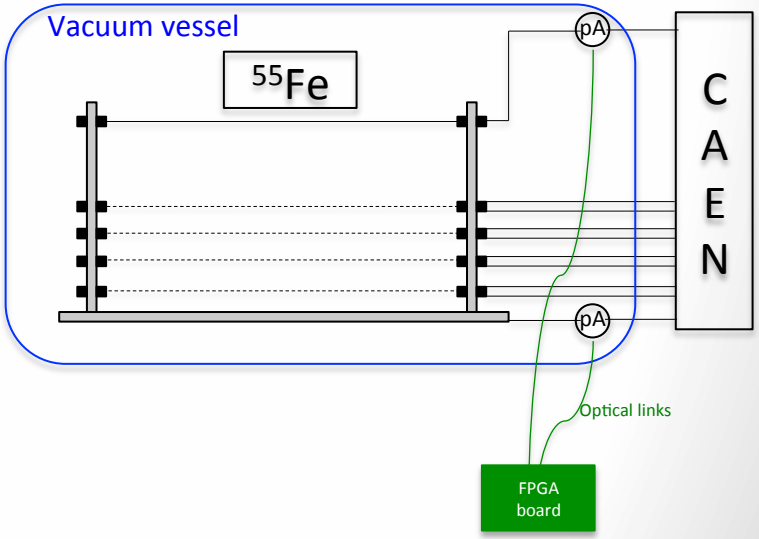


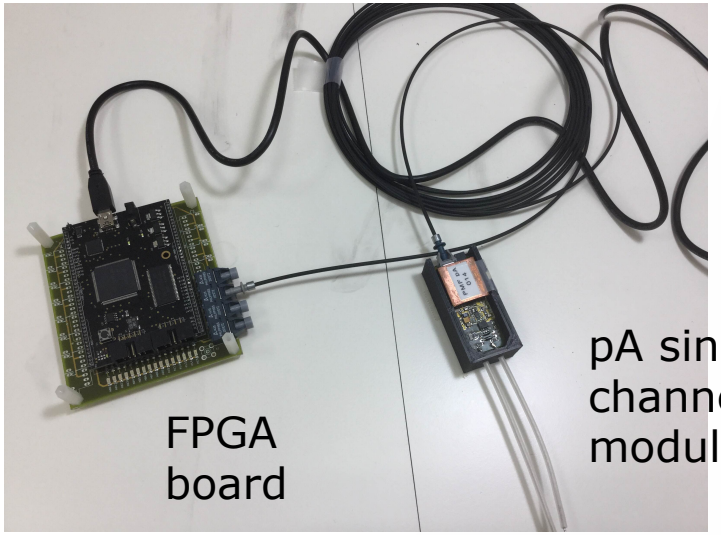
Figure 5.1: Sketch of the Munich quadruple GEM setup.

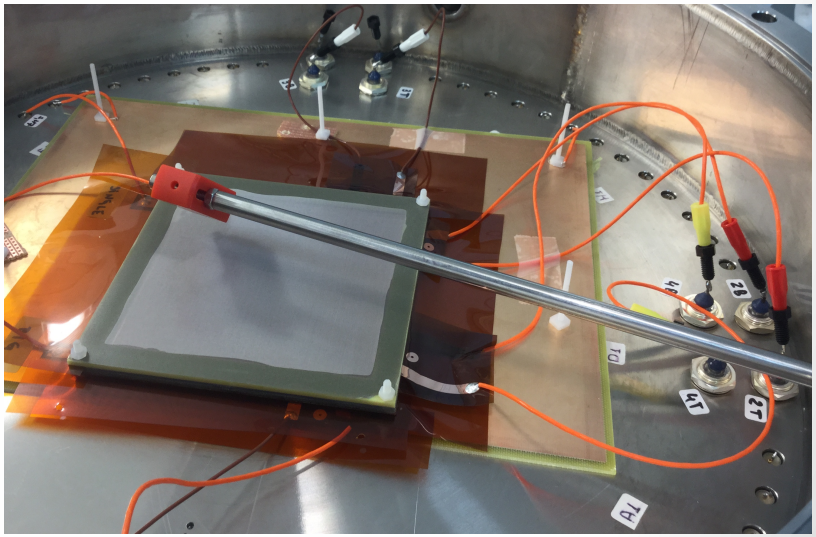


For measuring the IBF currently in a standalone vessel:

- 4GEM layers: 10x10 standard + mesh
- ^{55}Fe source: ~7 kHz in the 5mm gap
- Readout with floating multichannel custom produced picoammeter modules up to 10 channels (instrumented 3)
- (100 nA absolute range, 8 pA resolution)

IBF measurements





Start with curves shown by Munich group

Measurements can include:

Changing gas mixtures
Change field setup

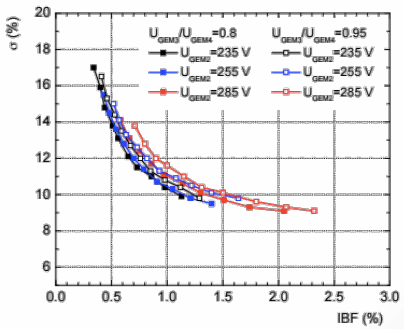
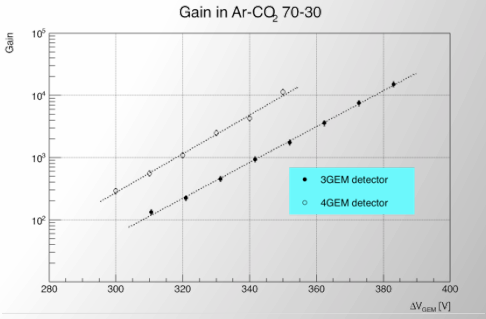


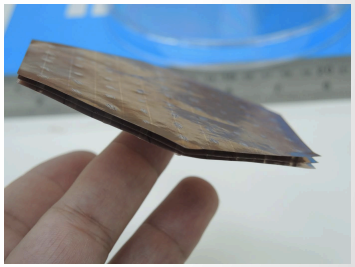
Figure 5.4: Correlation between ion backflow and energy resolution at 5.9 keV in a quadruple S-LP-LP-S GEM in Ne-CO_2-N_2 (90-10-5) for various settings of ΔU_{GEM2}. The voltage on GEM 1 increases for a given setting between 225 and 315 V from left to right. The voltages on GEM 3 and GEM 4 are adjusted to achieve a total effective gain of 2000, while keeping their ratio fixed. The transfer and induction fields are 4, 2, 0.1 and 4 kV/cm, respectively.



Picture of the day

Amplification element

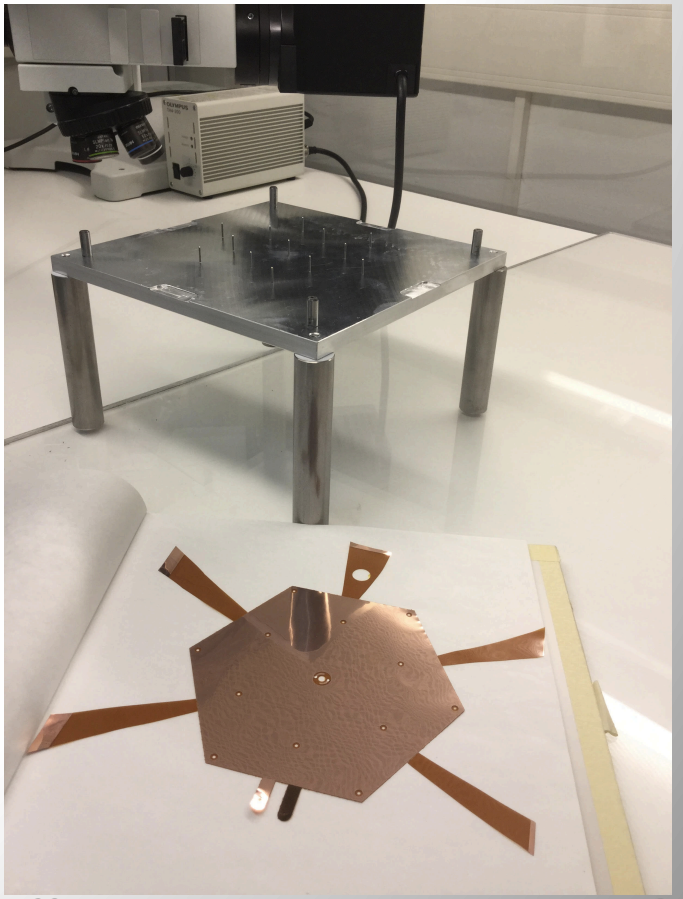
Basic idea: A GEM stack is rigid enough to support itself.



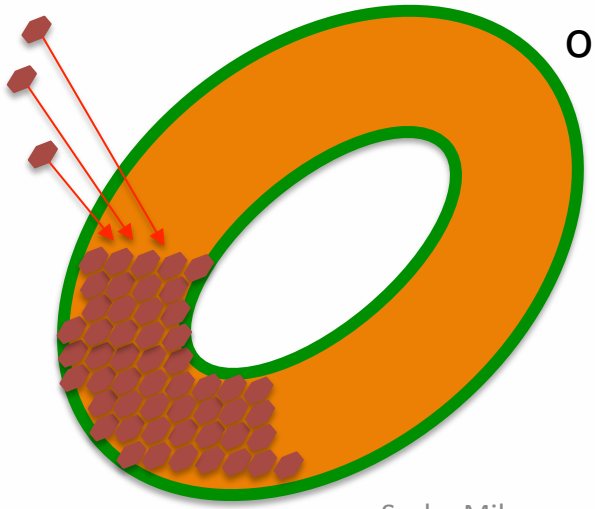
Can be built w/o frames: dead areas ~4% → below 2%

Modules should be small

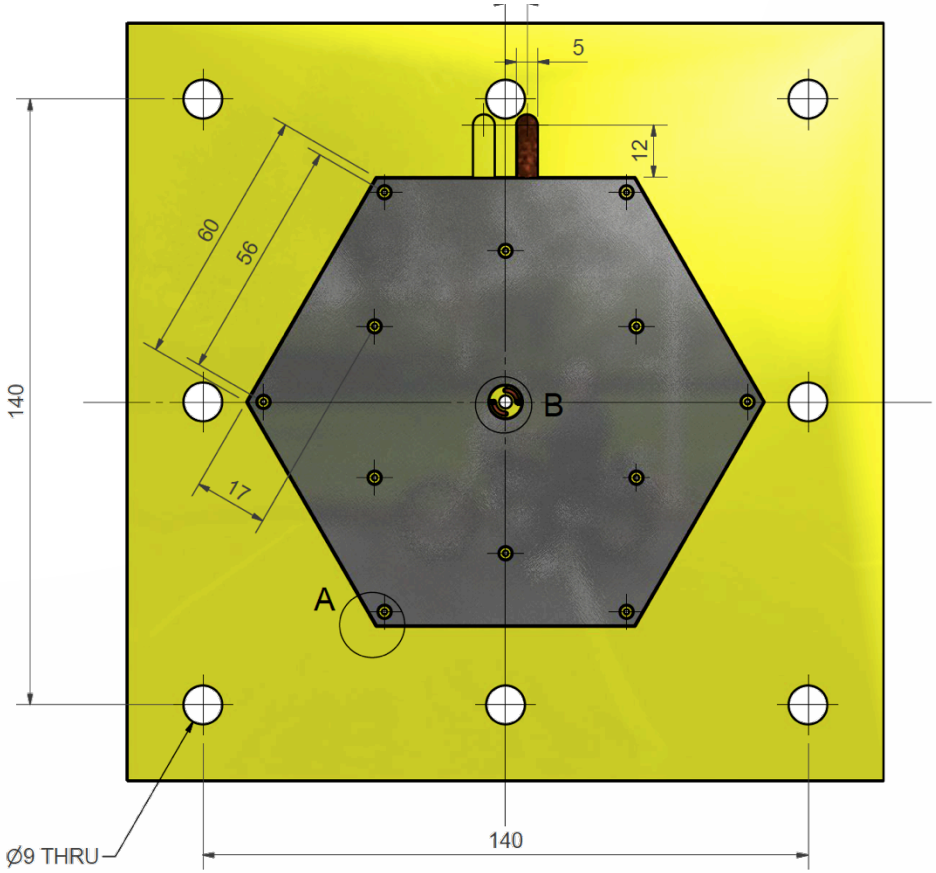
small modules are easy to handle
small modules can be mass produced
mass production reduces cost
low cost allows quality selection



Modules can have integrated divider in them
Selected and tested modules are mounted on the pad plane



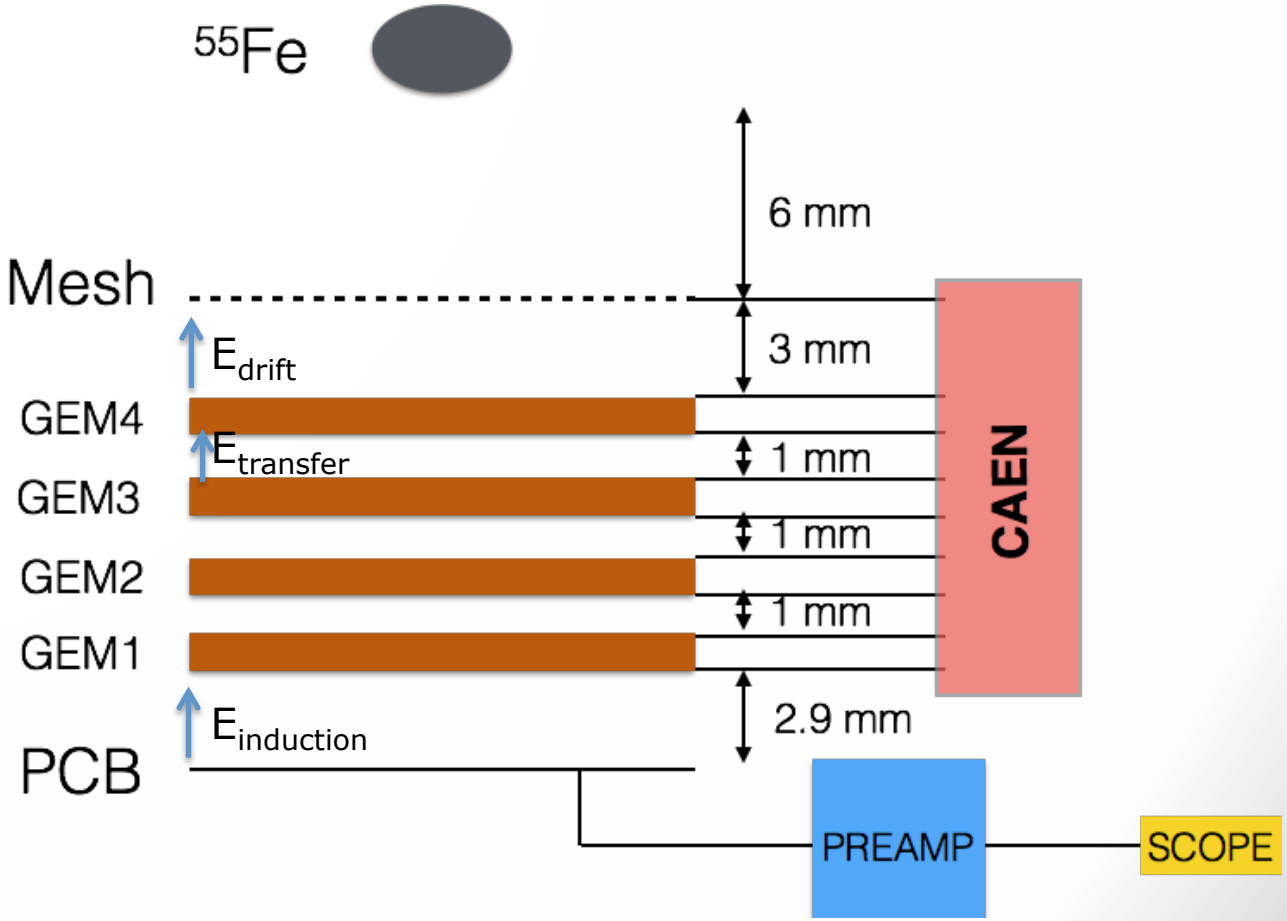
Current iteration (not final)



Total area:	93.5 cm^2
Central divider:	0.5 cm^2
12 Stands:	0.8 cm^2
Rim 600um h-t-h:	2.2 cm^2
Total dead area (*)	
Concentrated	1.4%
Distributed	2.3%

(*) Overestimated and before any optimization

4GEM detector



Individually biased electrodes allow easily to change drift, induction and transfer fields.

Plans

1. Start with the IBF
2. Bring up the second box for all other measurements done to be done with gases
3. Make working prototype of the 4-layer GEM stack,
4. Make 1st iteration of integrated divider
5. Move to prototype-2